Recent Update on MODIS/VIIRS Deep Blue Data Continuity and New Aerosol Products

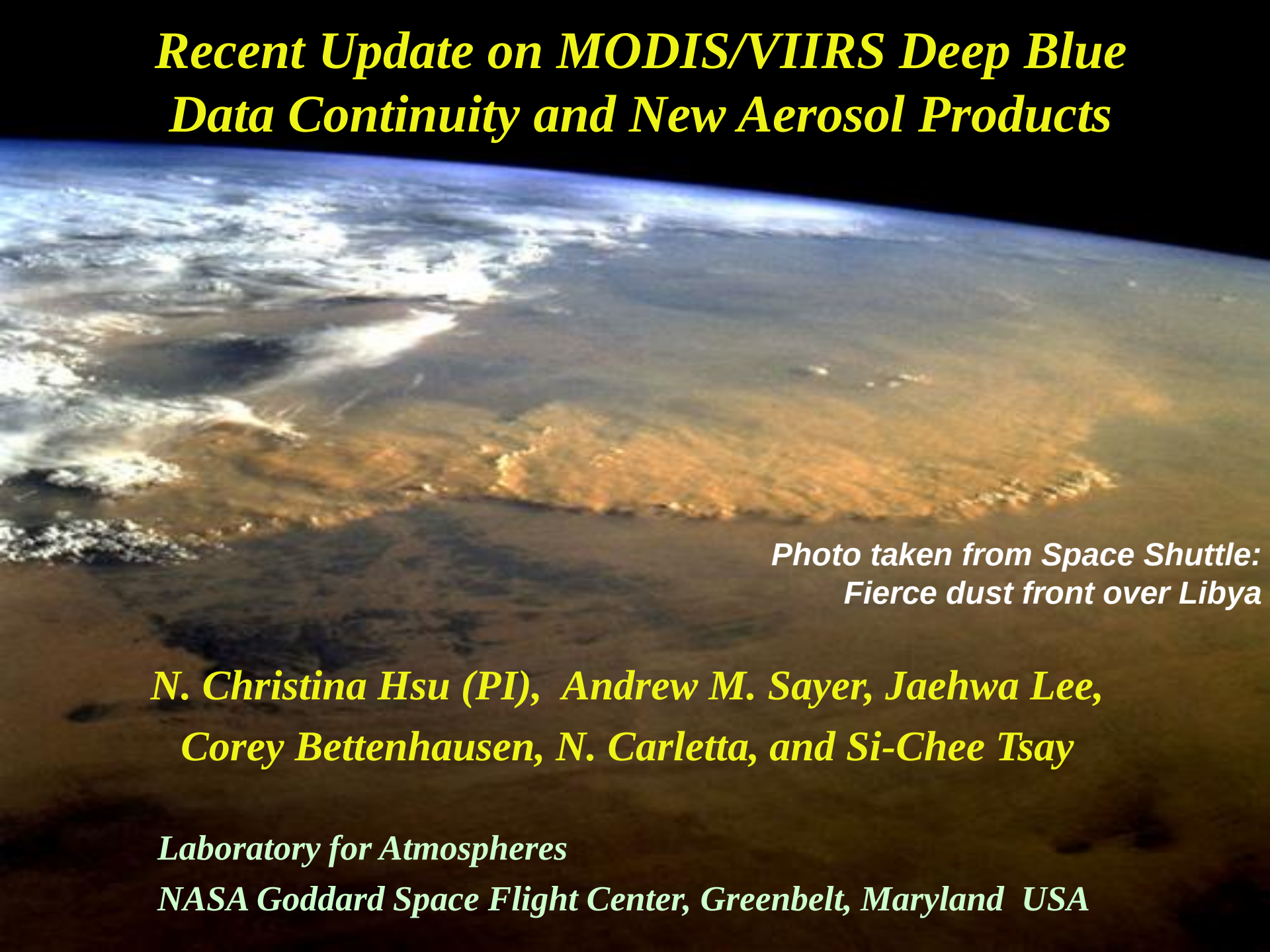

Photo taken from Space Shuttle:
Fierce dust front over Libya

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Corey Bettenhausen, N. Carletta, and Si-Chee Tsay

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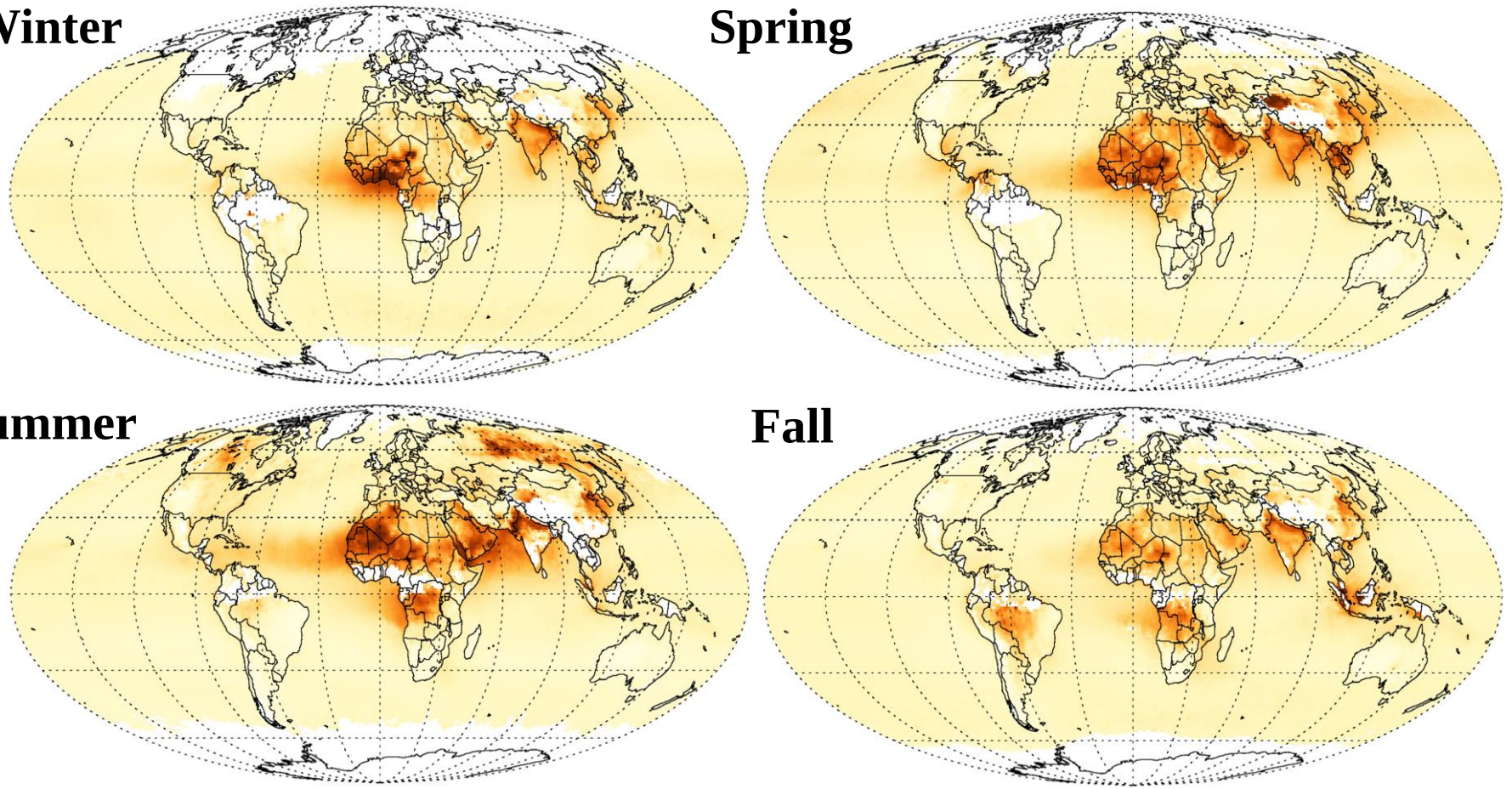
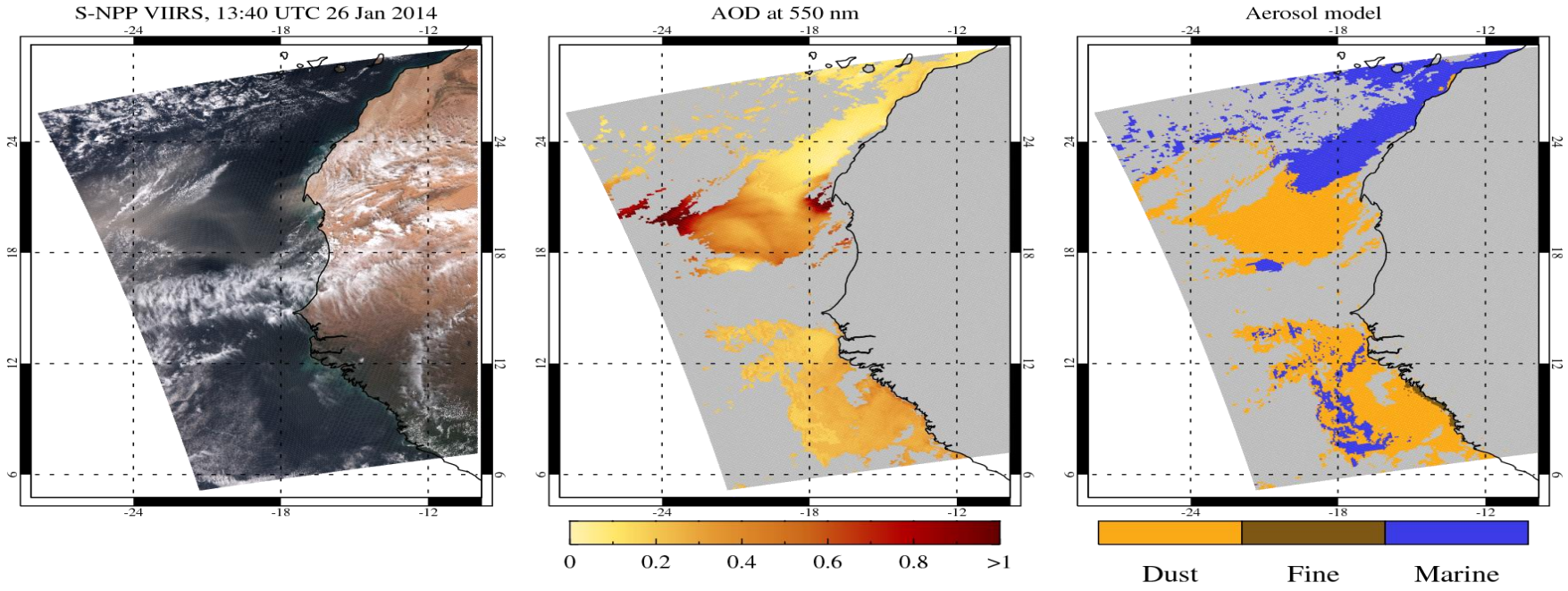
Recent Progress on Deep Blue Aerosol Algorithm for VIIRS

- *Expand coverage from arid and semi-arid regions into vegetated (SeaWiFS, MODIS C6, and VIIRS) areas as well as oceans (SeaWiFS and VIIRS only)*
- *Develop and employ non-spherical dust models for aerosol retrievals*
- *Improve cloud screening to distinguish heavy smoke plumes from clouds*
- *Account for the effect of water vapor in identifying strongly absorbing mineral dust using the IR channels*

VIIRS 2012-2016 Seasonal 550nm AOD Maps

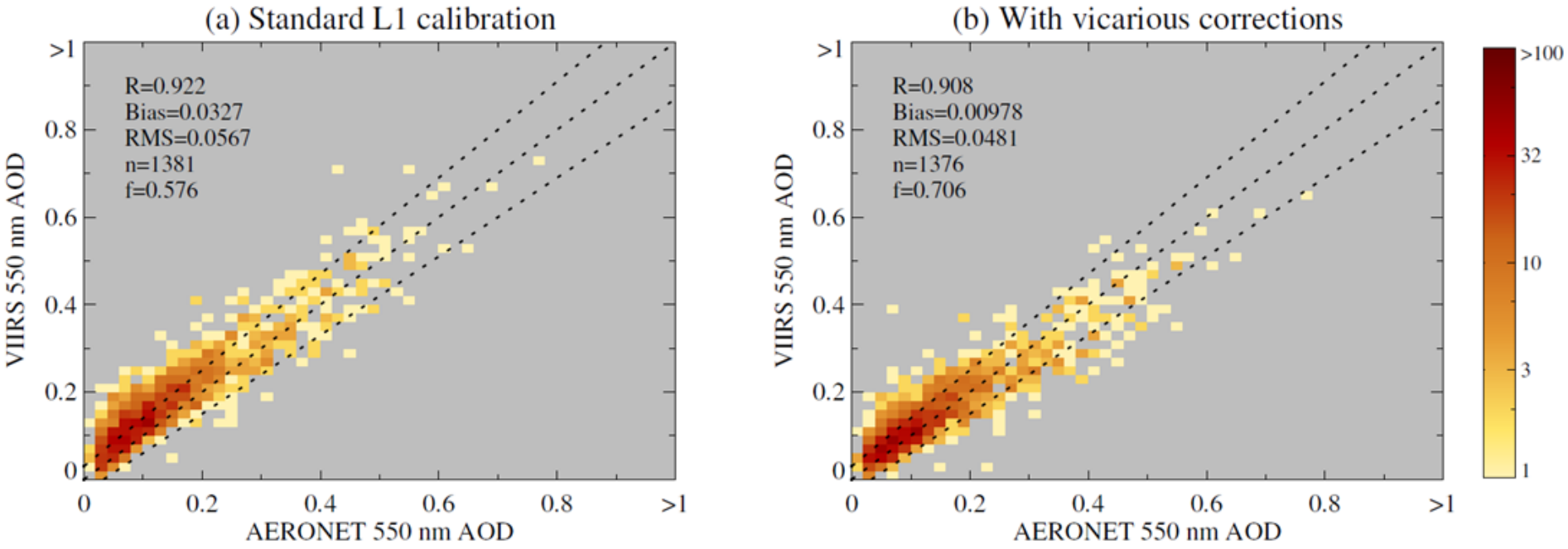


VIIRS ocean retrieval algorithm



- The VIIRS ocean algorithm is an extension and improvement on our SeaWiFS algorithm
  - Similar in principle to other common approaches (e.g. MODIS) as well
- Retrieve AOD, fine mode fraction (Ångström exponent), aerosol type (from a selection of models)
  - Includes nonspherical dust model
- Cloud screening seems effective even in cases of heavy aerosol loading

Effects of VIIRS Vicarious Calibrations on AOD retrievals

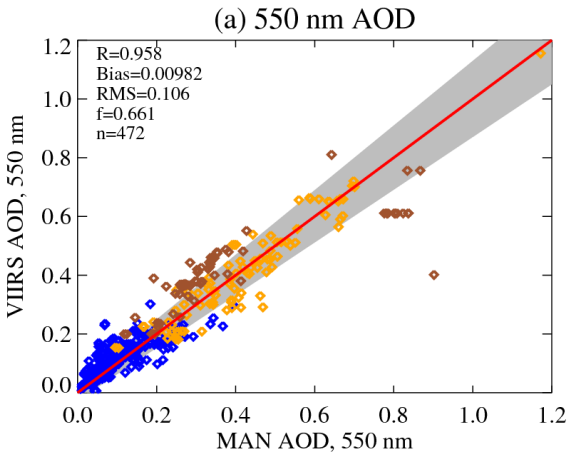


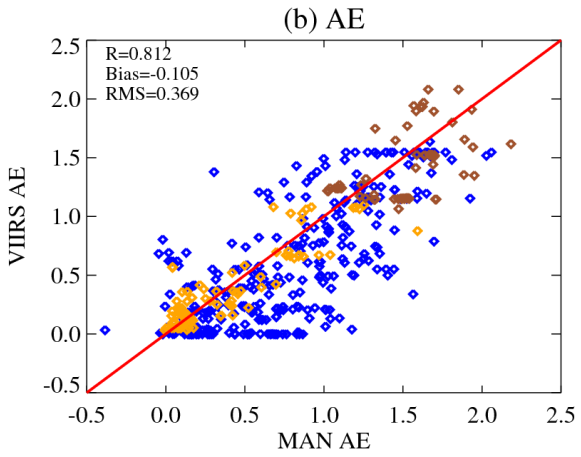
- **Applying these corrections removes the bulk of the AOD bias over water**
- **Suggest MODIS absolute calibration is closer to the truth than VIIRS**

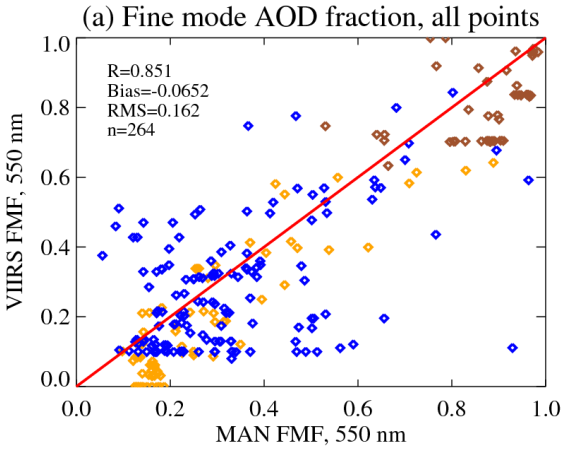
Fore more details, see our poster (Atmospheres section): Sayer *et al*., "Vicarious calibration of S-NPP VIIRS reflective solar M-bands against MODIS Aqua over dark water scenes"

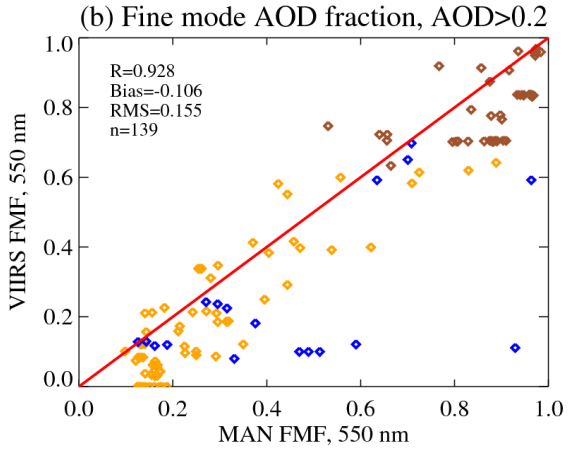
Comparisons of VIIRS ocean products with Maritime Aerosol Network (MAN)

- AOD retrieval quality similar to, or better than, standard MODIS product
- Ångström exponent (AE) and fine mode AOD fraction compare favorably to MAN data, even when the AOD is not high
- Colors indicate aerosol optical model: retrieved, not prescribed
  - Either **marine**, **dust**, or **fine-dominated**



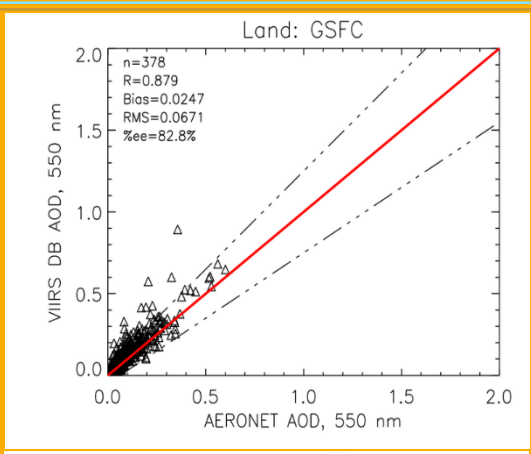


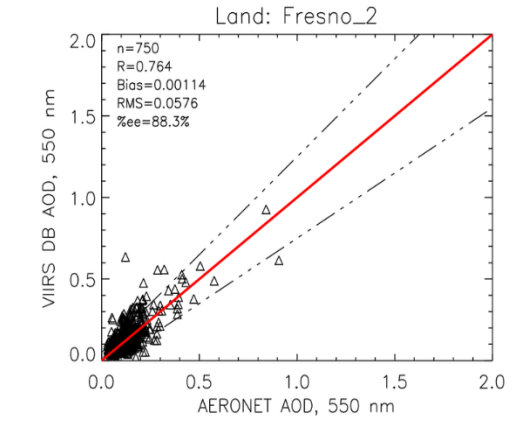


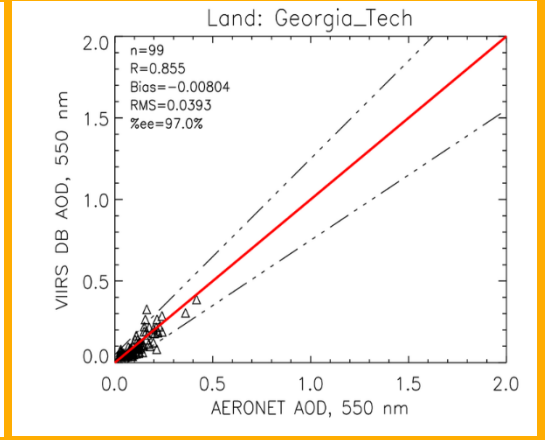


VIIRS Comparisons with AERONET AOT over Land

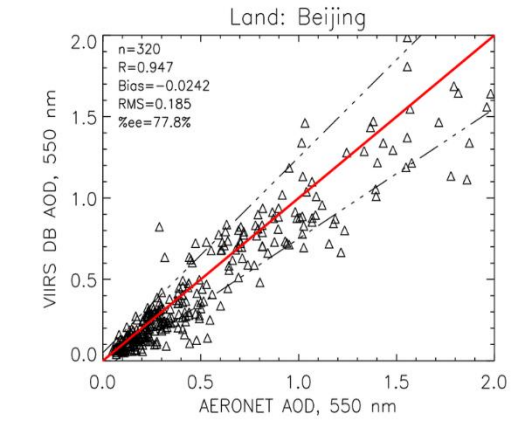
Urban Pollution

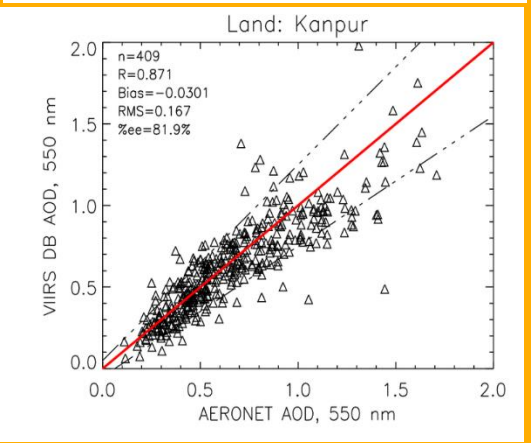


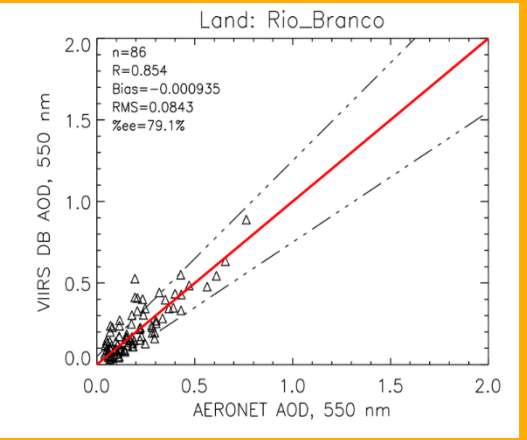




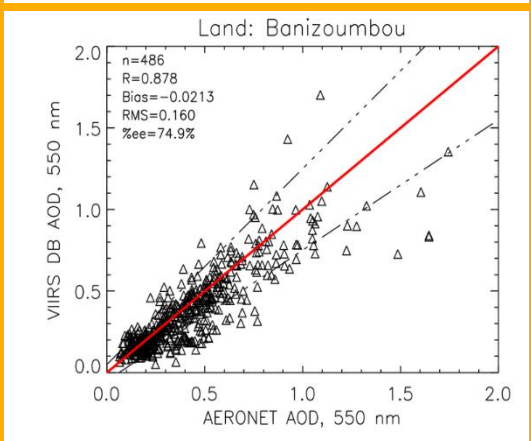
Urban Pollution, Dust, Smoke

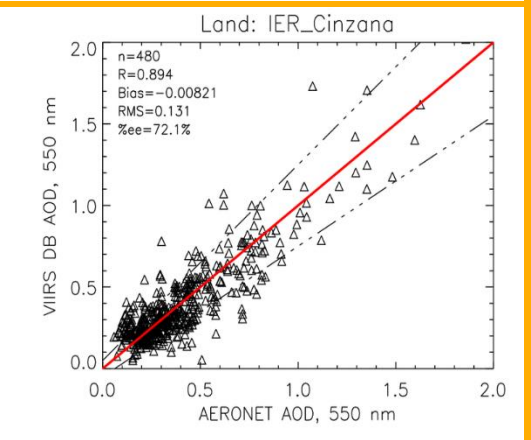


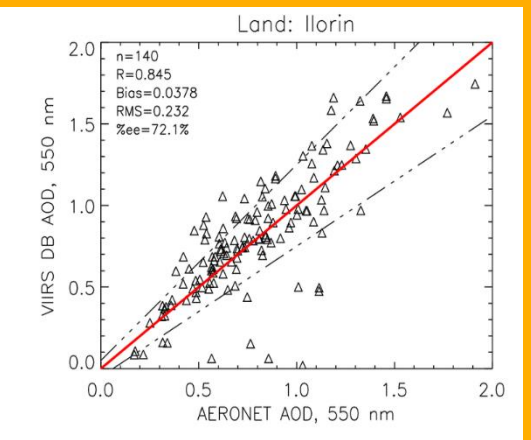




Sahel

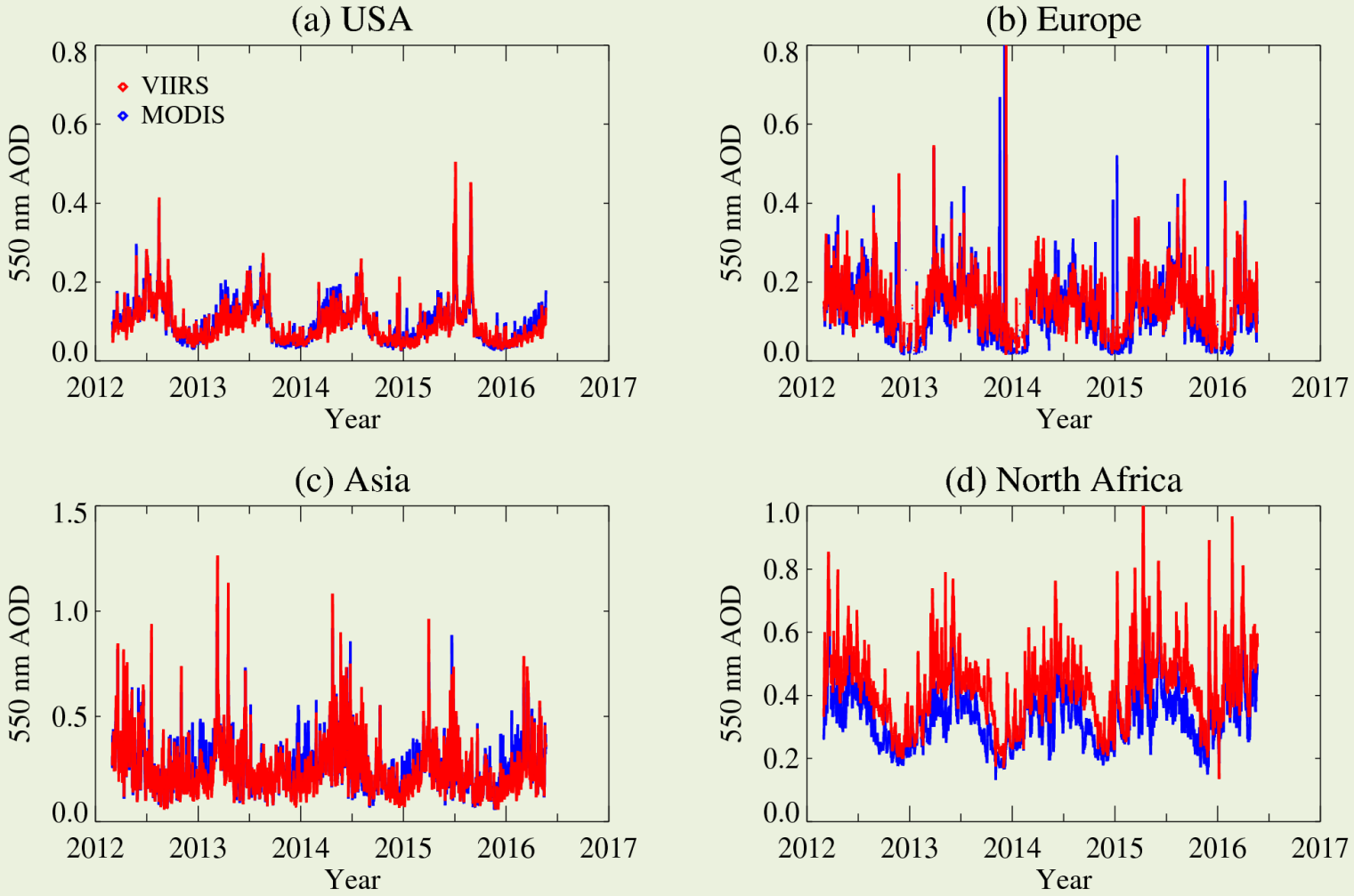






Long-Term Data Continuity From MODIS to VIIRS

Comparisons of Daily VIIRS vs. MODIS Regional AOD



- **The AOD values from VIIRS and MODIS are comparable on regional scales; An important step toward a consistent aerosol data record from MODIS to VIIRS**

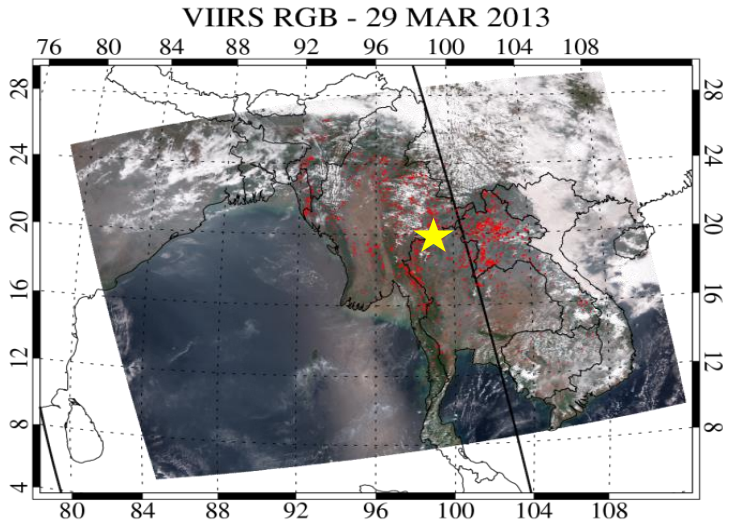
Planning for MODIS Collection 7:

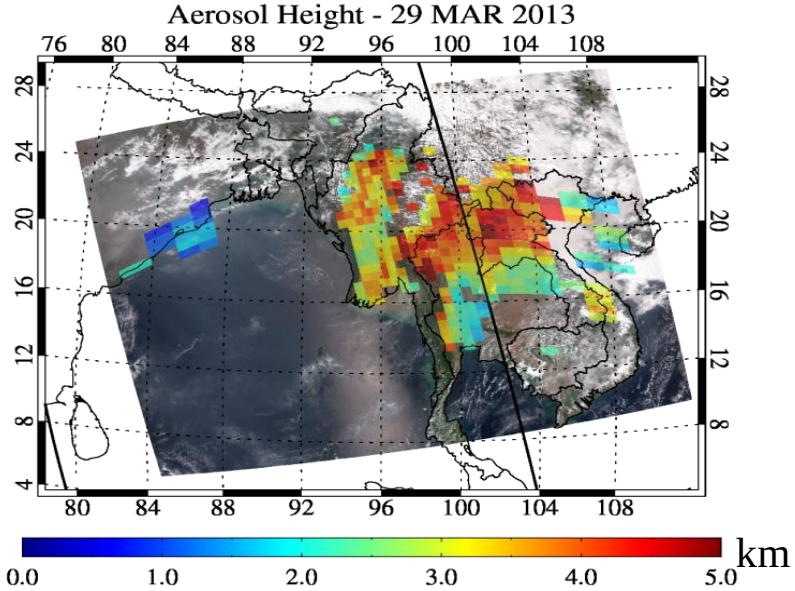
(1) Provide new *Aerosol Plume Height* product using combined MODIS and OMI data

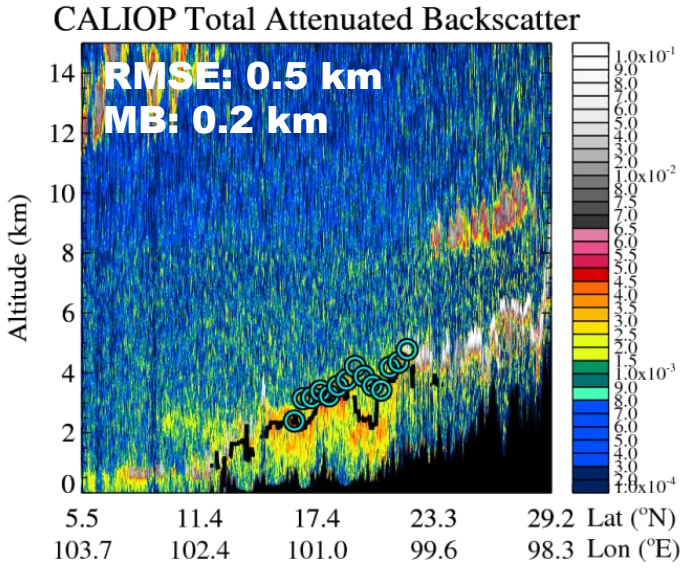
(2) Extend *Deep Blue* Aerosol products from Cloud free to Cloudy regions

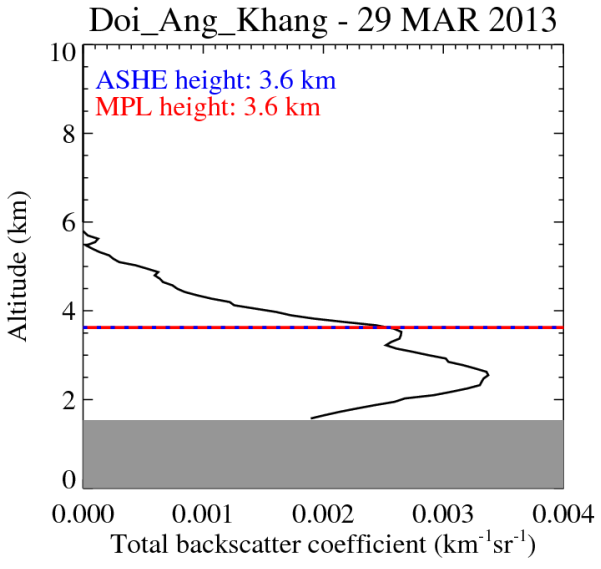
Validation using data from 7SEAS field experiment over Southeast Asia

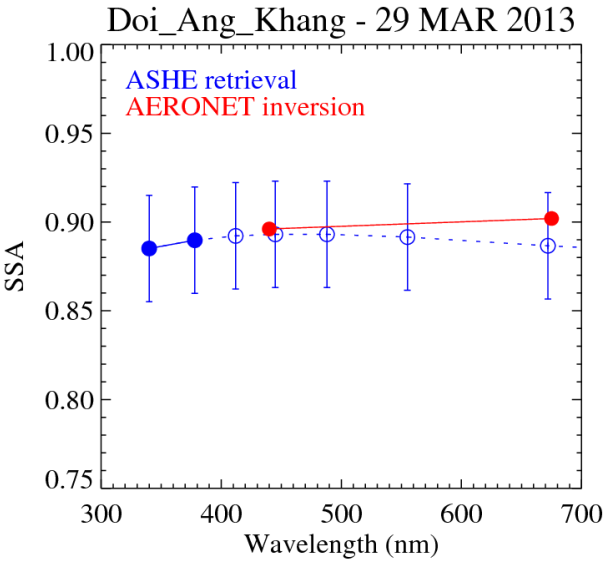
For more details, see our poster: Lee *at al*., Retrieving the height of smoke and dust aerosols by synergistic use of multiple satellite sensors











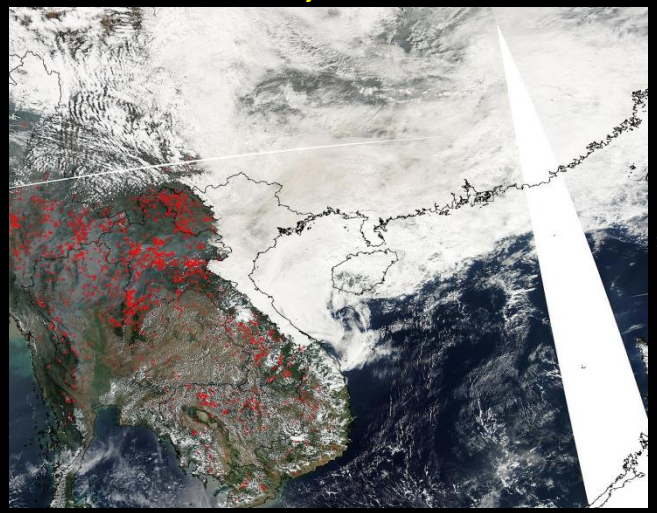
Planning for MODIS Collection 7:

(1) Provide new *Aerosol Plume Height* product using combined MODIS and OMI data

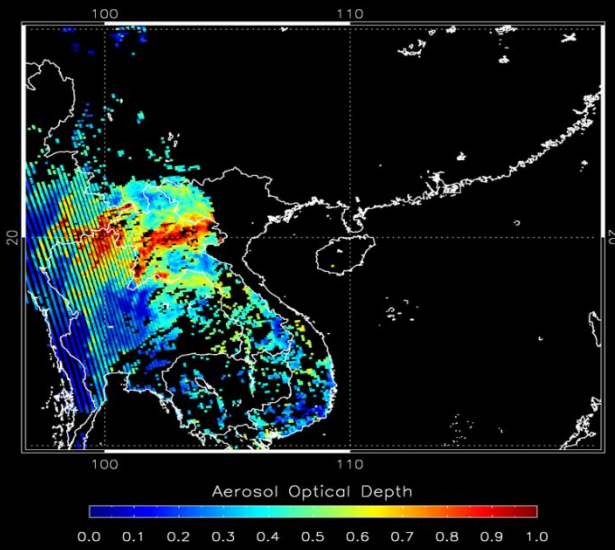
(2) Extend *Deep Blue* Aerosol products from Cloud free to Cloudy regions

New Deep Blue Aerosol Products for MODIS C7: AOD and Aerosol Forcing above Clouds

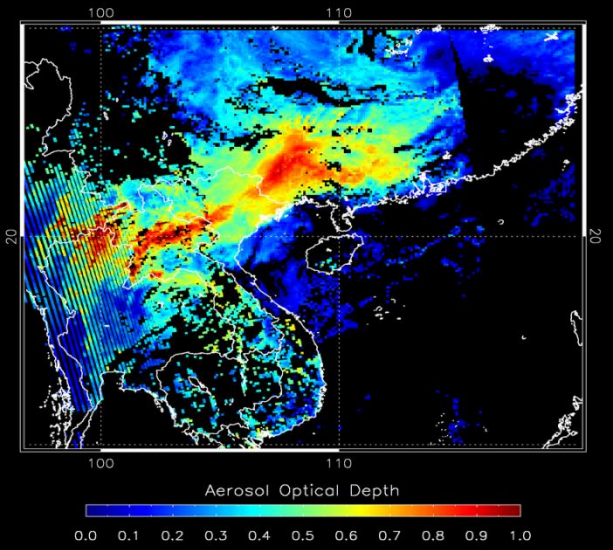
Aqua/MODIS RGB
March 6, 2009



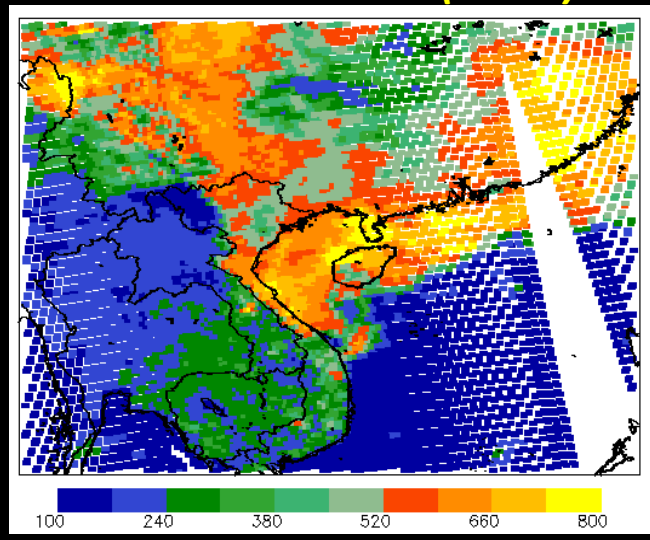
MODIS C6 Deep Blue AOD



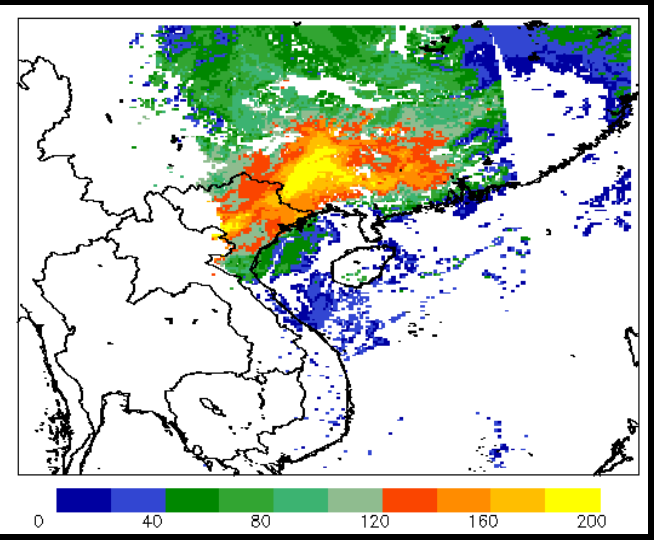
MODIS C7 Deep Blue new AOD above clouds

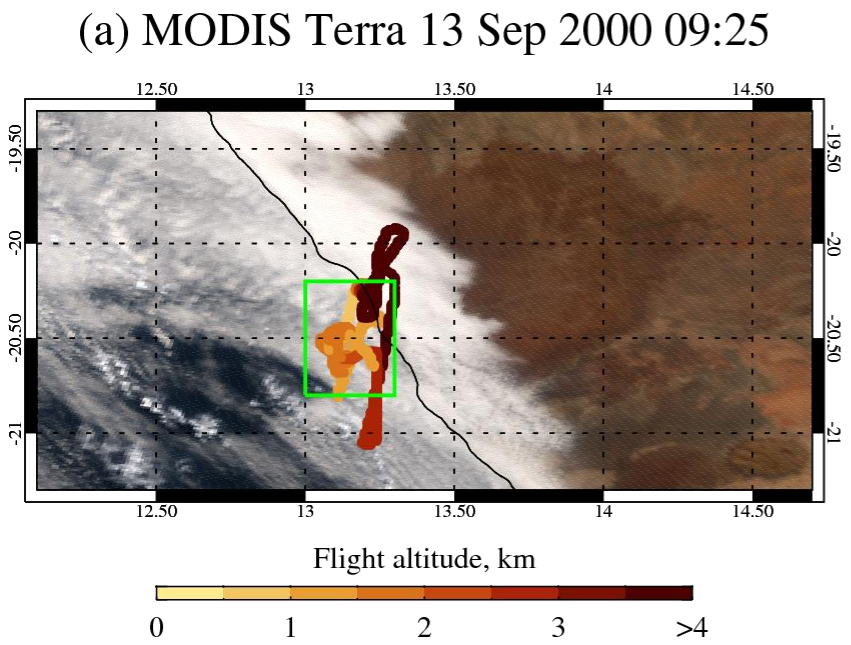


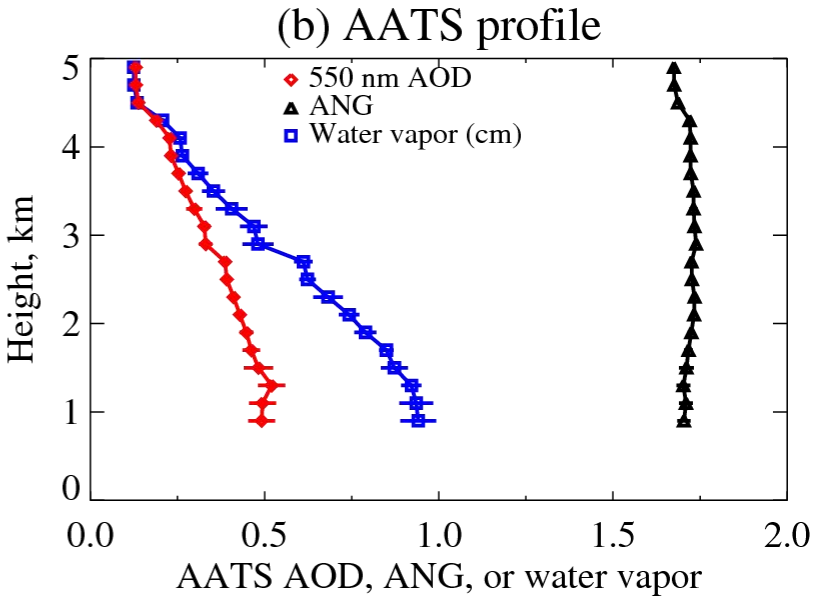
CERES TOA SW Flux (Wm^{-2})



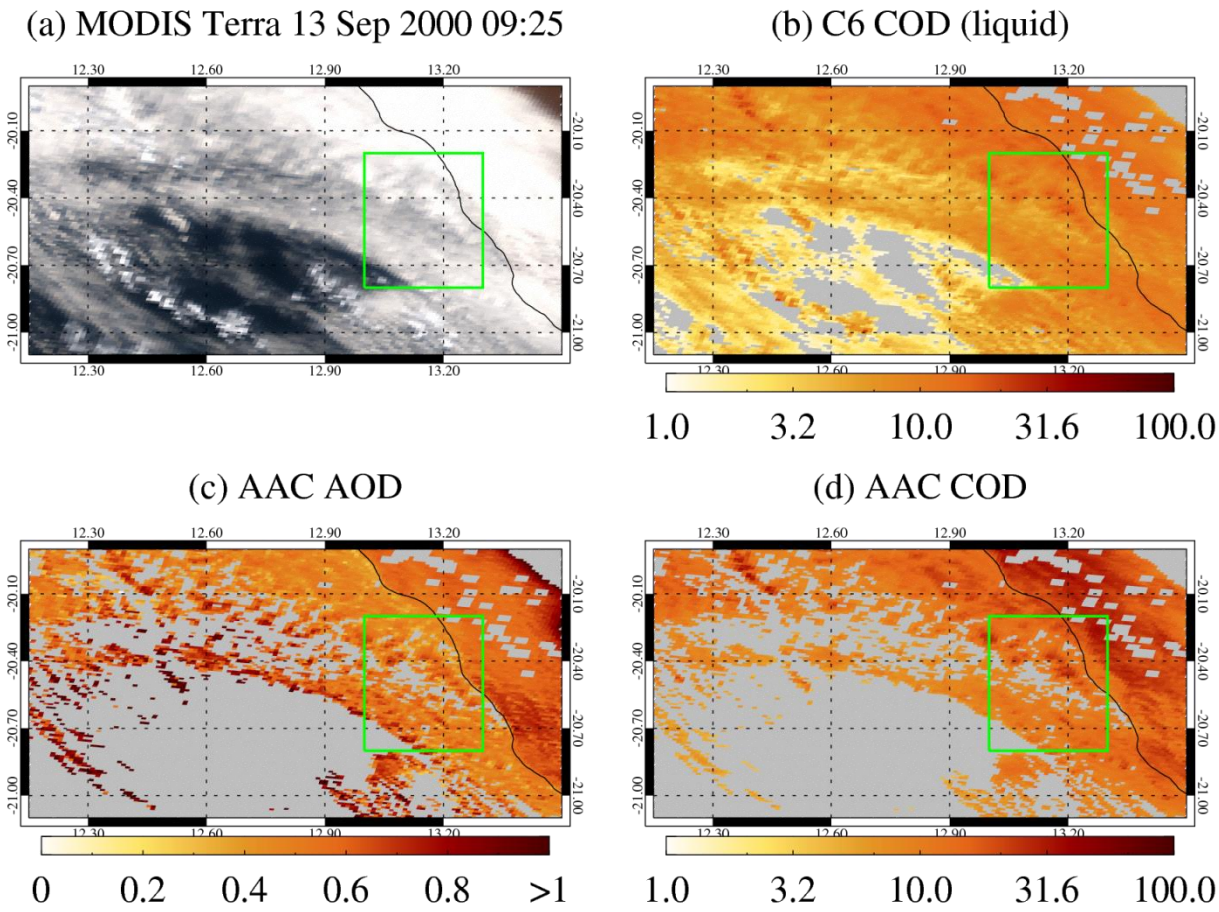
MODIS Deep Blue Aerosol Forcing (Wm^{-2})







- Validation case studies: take advantage of field campaign observations of aerosols above clouds
  - Observations from the Ames Airborne Tracking Sunphotometer (AATS; http://geo.arc.nasa.gov/sgg/AATS-website/)
    - For our purposes, a bit like an AERONET Sun photometer on a plane
  - Example from SAFARI-2000: smoke over a flat (~1 km) stratocumulus deck off the coast of Namibia



- AATS 550 nm AOD: **0.49+/-0.02**; our MODIS AOD retrieval: **0.51+/-0.09**
- Our COD is well-correlated with but ~50% higher than operational C6 product, consistent with strong absorption by the smoke

Reference: Sayer et al., 2016, JGR, Extending `Deep Blue' aerosol retrieval coverage to cases of absorbing aerosols above clouds: sensitivity analysis and first case studies

- **Selected as a Research Spotlight by AGU: https://eos.org/research-spotlights/measuring-atmospheric-aerosols-despite-the-clouds**

Extending Deep Blue Aerosol Products From LEO to GEO: Preliminary Results Using Himawari-8 Observations

Summary

- **Based upon the comparisons with AERONET AOD global observations, the expected error for VIIRS DB is 0.05±20% over land and 0.03±10% over ocean, which is comparable to that for MODIS DB. The AOD time series from VIIRS and MODIS are consistent with each other.**
- **Thanks for the support from Atmosphere SIPS at Wisconsin, VIIRS version 1 DB aerosol products will be ready for release to the public in the summer of 2016.**
- **We have started planning for the MODIS C7 reprocessing to implement aerosol plume height and aerosol above cloud retrievals into the Deep Blue algorithm. The corresponding algorithm descriptions and preliminary validation results have been published in peer-reviewed journals.**